# *Sensor Technologies for The Objective Force*

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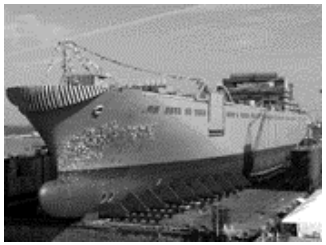
10 October 2000

# Objective Force and FCS: New Army Vision

## Full Spectrum Air Deployable Force (C-130) by 2008+

## - 96 hours for one brigade

S&T Supports Objective Force /FCS - not BCT



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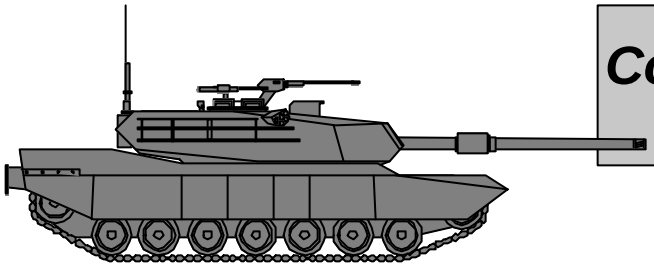


Combat Vehicle Weight

System of Systems ?

70 Tons

20 Tons

Heavy Armor (frontal arc)

…and Survivability

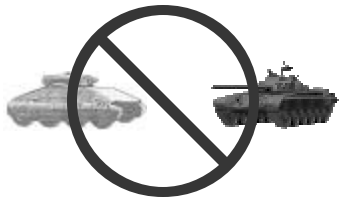
Situation Awareness and Integrated Protection

# *Why Sensors for the Objective Force and FCS?*

***Survivability*** **of a medium weight force is dependent on sensors:**

**-- High quality situation awareness (SA) is the key to avoiding unintentional close combat and supporting Beyond-Line-of-Sight (BLOS) targeting**

**-- Combination of distributed sensors and the network to interconnect them is the source of SA**



**Advanced sensors can add capability at *reasonable cost***

***However,*** **the investment paradigm must change:**

**-- Both on-board and off-board sensors important**

**-- Must deal with threats in complex terrain**

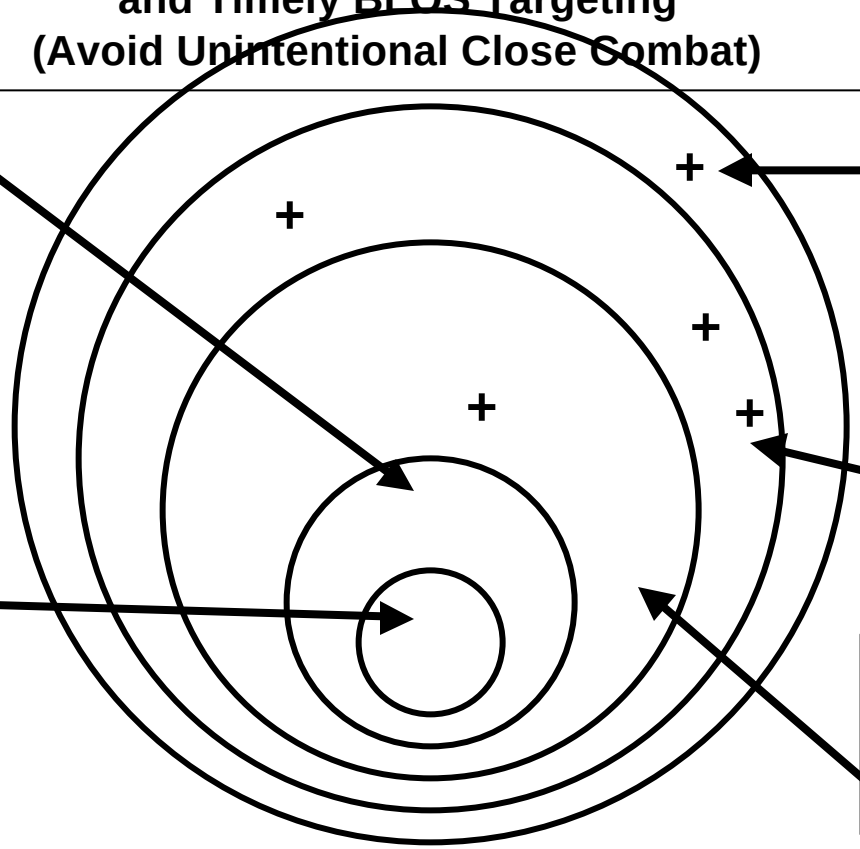
**-- Affordability is still critical**

**Substitute Information for Armor**

**Implement: SEE FIRST - SHOOT FIRST - KILL FIRST**

# *Layered Surveillance for the Objective Force/FCS*

**Goal: Complete Situation Awareness and Timely BLOS Targeting (Avoid Unintentional Close Combat)**



**Manned Security Screen**

**Global Surveillance**
- **Satellite**
- **JSTARS**
- **Global Hawk**
- **Predator**

**Brigade Surveillance**
- **TUAV**
- **Comanche**
- **Other Larger UAV?**

**Close Combat S.A. (Head tracked esp. vs dismounted)**

**MLHSA (mobile WEBS)**
- **Mini-UAV**
- **UGV**
- **UGS**

***( + = SOF or LRRP)***

***Biggest Challenge is for offensive operations***

**The Problem: Targets Hiding in Complex Terrain**

**The Solution: Networked Unmanned Sensors**
**Multiple Look Angles (High and Low)**
**Continuous Tracking with Cross Cueing**

**Last Resort: Manned Security Screen**

# *Distributed Off-Board Sensor Technologies for Beyond Line of Sight Situation Awareness*

Networked Organic Sensors for BLOS Situation Awareness and Targeting that Complement Global Surveillance which is hampered by Shadowing, Foliage, CC&D, MTI thresholds, time lag, etc.

- Over-the-horizon sensors for the brigade critical to
  - –Avoiding unintended engagements and
  - –Enhancing BLOS targeting
  - –Access to overhead MTI critical

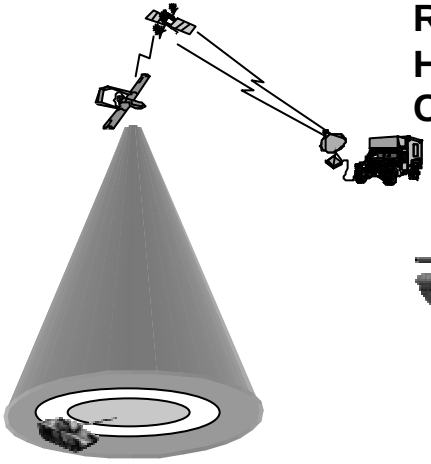
**Tactical Unmanned Aerial Vehicles (TUAV)**

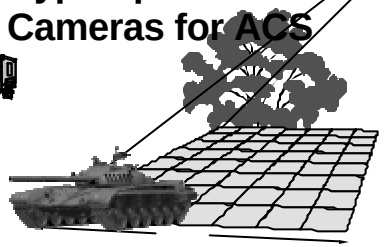
**Uncooled IR for Mini-UAVs**

**Advanced EO/IR and SAR / MTI RADAR for TUAV**

**High altitude foliage penetration**

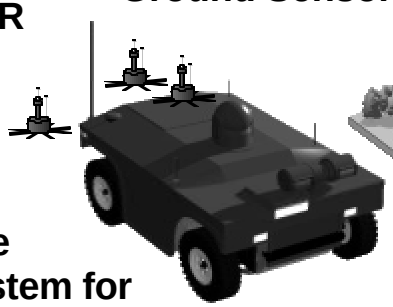
**SIGINT, FoPen Radar and Hyperspectral Cameras for ACS**

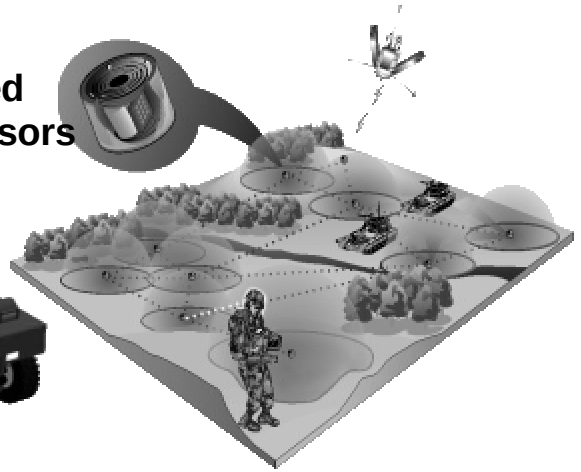




**3D Laser RADAR**

**Unmanned Ground Sensors**





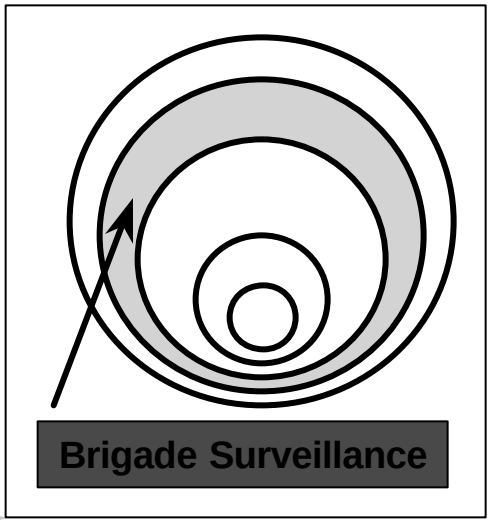
**Cost Effective Targeting System for Unmanned Ground Vehicles**

**Over-the-Horizon surveillance, improved situation awareness, and BLOS targeting**

# *TUAV Sensor Payloads*

## Relevance :

- **Over-the-horizon sensors for the brigade critical to**
  - **Avoiding unintended engagements and**
  - **Enhancing BLOS targeting**
  - **Access to overhead MTI critical for Objective Force / FCS**




***EO/IR plus Radar***

- **Also other functions such as**
  - **Rapid terrain mapping**
  - **Chem/Bio aerosol detection**

  } ***Combine with 1.06 um low resolution LIDAR***

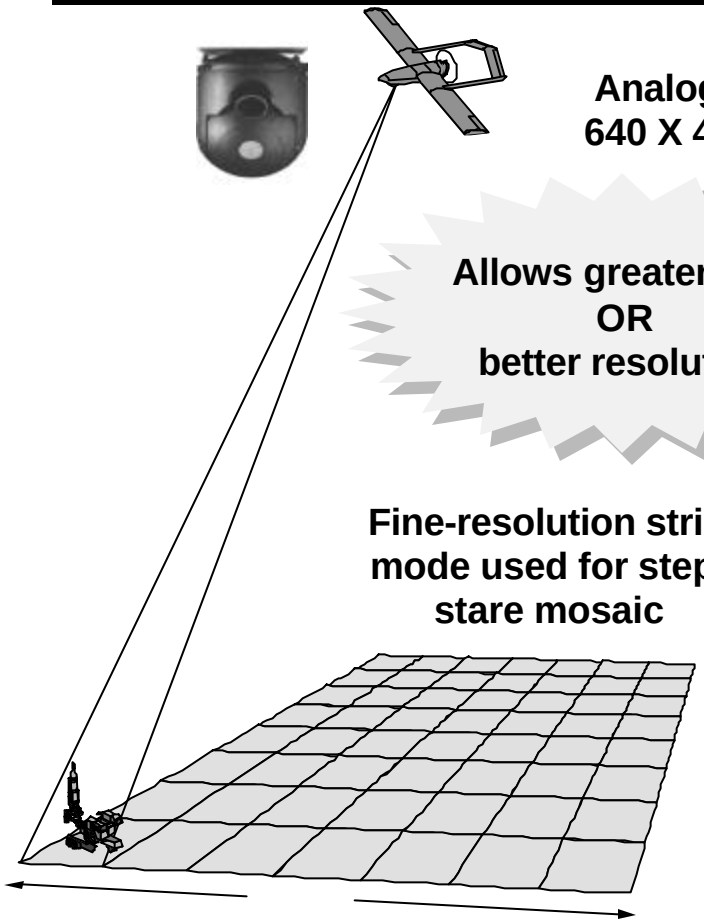
  - **Hyperspectral for detecting difficult targets (day/night and weight issue)**
- **Plug and Play approach to quickly switch specialized payloads**

**Challenge, except for EO/IR, is weight reduction**

**52 lb. max (at best) payload for Army TUAV**

# *Advanced EO/IR Sensor Payload for TUAV*

**Payoff: Brigade Over-the-Horizon improved situation awareness, target ID and targeting against BLOS threats**

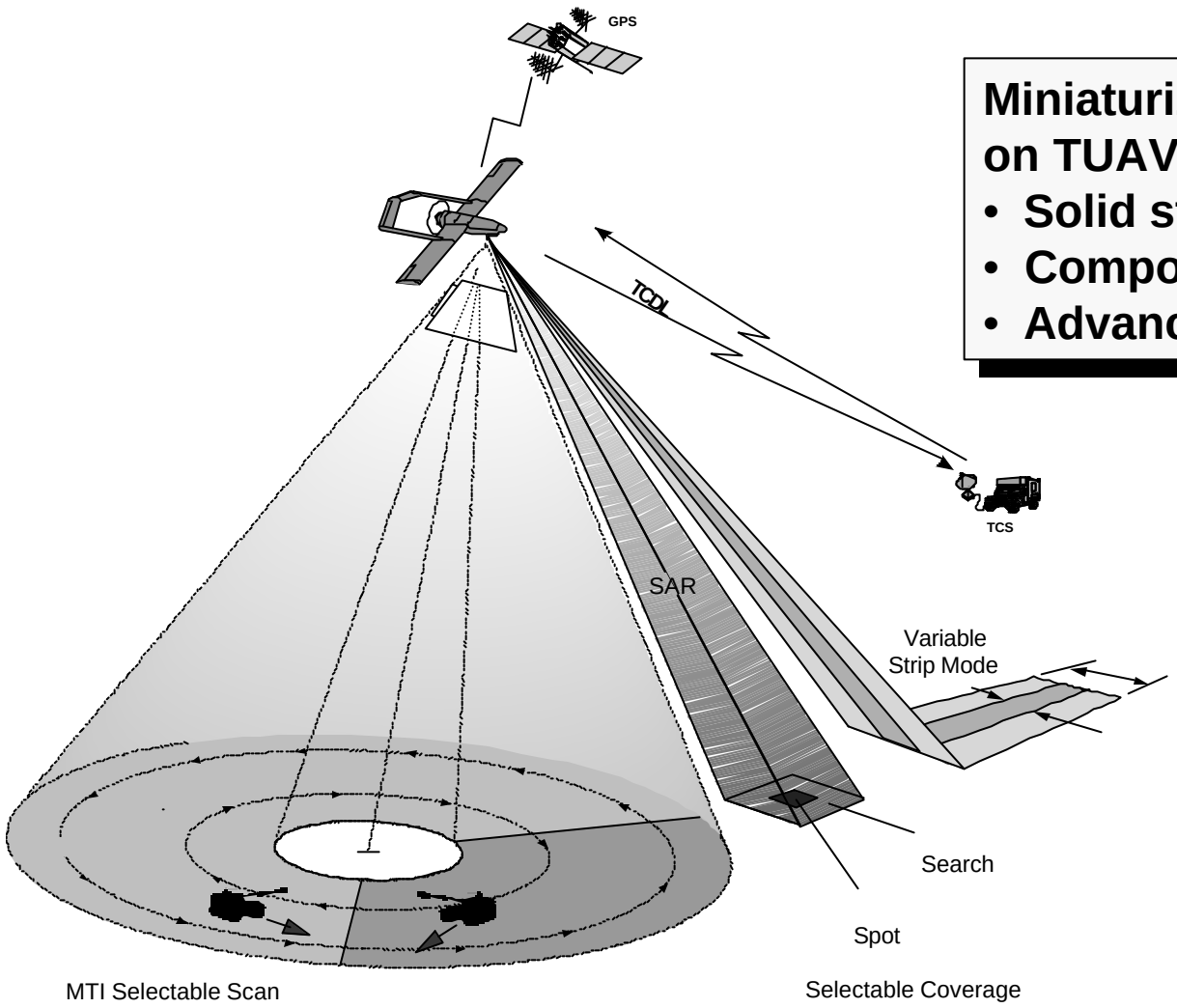



- **COTS MWIR InSb FPA with gimbaled step stare for fine resolution strip map mode**
- **NIMA compliant, all digital output (14 bit) for direct ATR compatibility**
- **High target location accuracy**

***Larger Detector Array Provides Needed Standoff Range and Search Capability***

# SAR/MTI Radar Payload

**Payoff: Brigade Over-the-Horizon adverse weather target search and ID plus targeting for BLOS weapons and wide area surveillance capability against moving targets**




**Miniaturization of current radar to fit on TUAV encompasses:**

- **Solid state transmitter**
- **Composite materials for chassis**
- **Advanced processor architecture**

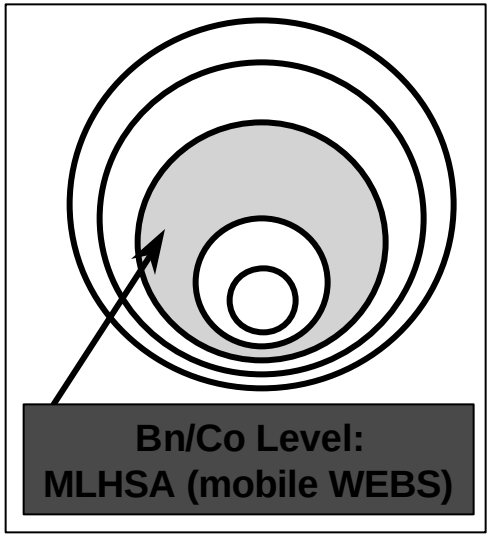
**Access to overhead MTI critical and avoids shadowing problems of JSTARS**

**Critical for Objective Force / FCS**

# *Objective Force / FCS RSTA Mobile Local Hostile Situation Awareness*

**Relevance :**

**"Tactical and engagement level situation awareness, and extended range tactical engagement (including beyond line of sight), have the highest payoff of any protection option."** Army Science Board, FY-99




**Solution:** **Networked Organic Sensors for BLOS Situation Awareness and Targeting that Complements Global Surveillance which is hampered by Shadowing, Foliage, CC&D, MTI thresholds, time lag, etc.**

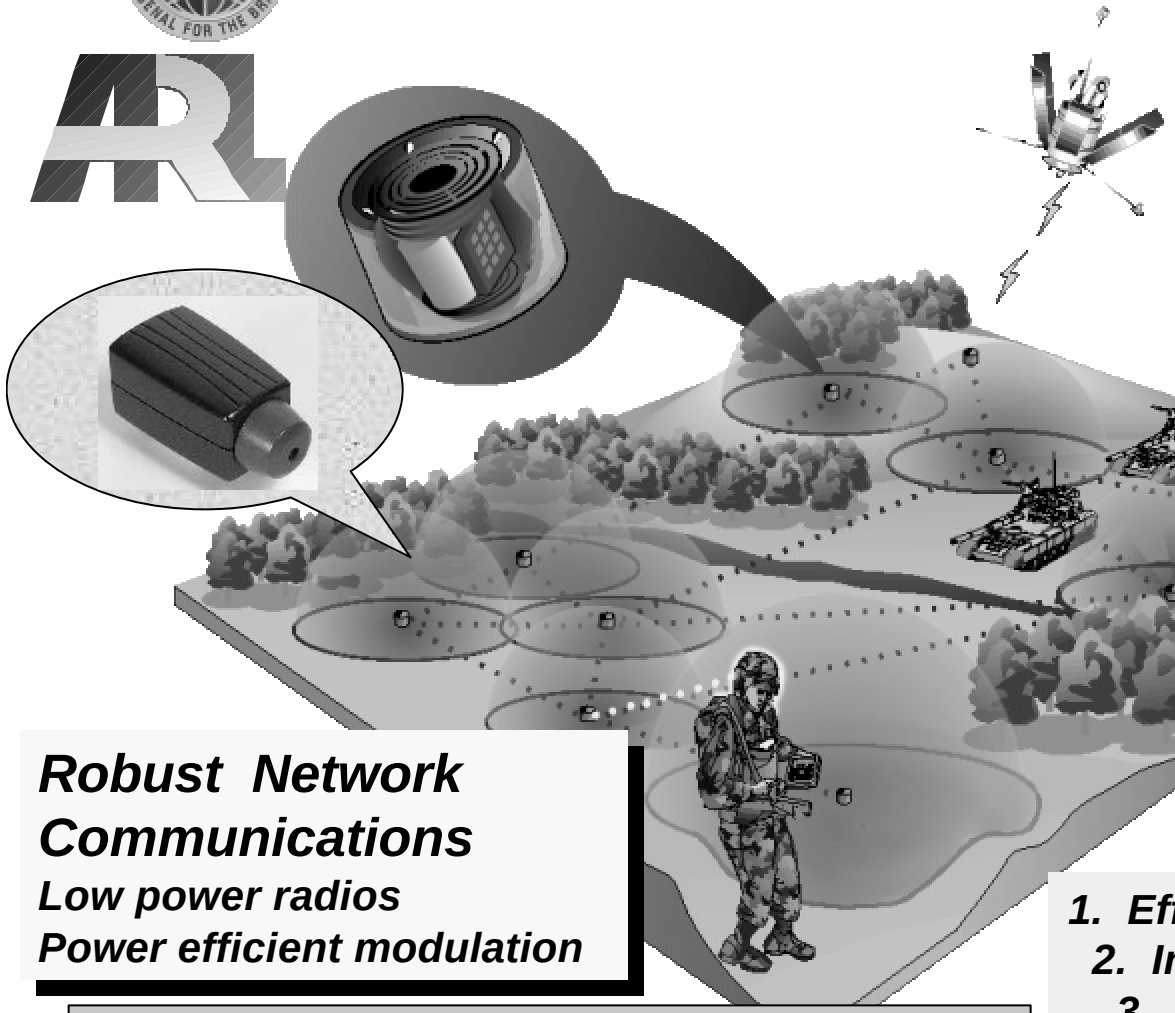
**Take advantage of relatively low cost distributed sensors: UGS, UAVs, Mini-UAVs and new deployment / emplacement techniques**

**Still a Big Challenge**

***Warrior Extended Battlespace Sensors (WEBS)***

*Army WEBS STO Program*

***Small, expendable unattended sensor capability***



***Wide Range of Sensor Types***

***Acoustic Magnetic Seismic***

**triggering**

***Low cost Day / Night Imagers (Low cost Uncooled IR)***

**Bandwidth**

***Radio Bandwidth***

**Batteries**

**"Bucks"**

***Robust Network Communications***

***Low power radios***

***Power efficient modulation***

***1. Efficient commo & signal processing.***

***2. Inherently low cost components.***

***3. Only send what you have to!***

**Enhanced by DDR&E Smart Sensor WEB's Program**

**Distributed Sensors provide highly reliable, situational awareness within a local area - Focus is on dismounted in Complex Terrain (MOUT)**

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# Uncooled IR Technology

### *OBJECTIVES*

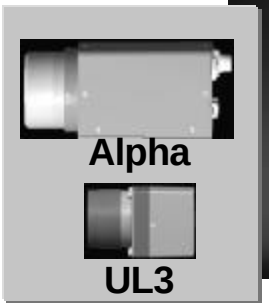
**Smaller Pixels/Increased Sensitivity**
**Larger Formats**
**No Mechanical Chopper**
**No Temperature Stabilization**
**Lower Power**
**Low Cost Optics**

**Leads *To***

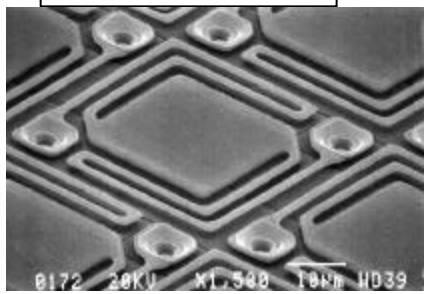
### *SENSOR PAYOFFS*

**Lower Cost**
**Longer Autonomous Life**
**Lighter Weight**
**Smaller Volume**
**Medium Performance**

***Baseline LOCUSP Sight***




***DUAP Product***



**Microbridge**

### *APPLICATIONS*

***New:***

**•Seekers / Munitions**
- **APLA**
- **UGS**
- **UGV**
- **Mini/Micro UAVs**
- **Goggles for MOUT**

**•Head Tracker SA**

***Lower Cost/Improved:***

- **Rifle Sights**
- **Driver Aides**
- **Physical Security**
- **Seekers**

**Advanced Uncooled**

***Low Cost through Dual Use Commercial Volume***

**Low Performance Driven By Commercial Market -**
**Night Imaging < $1K for the First Time, New Applications**

**Medium Performance Enables**
**Affordable Sensor Suites (with Eyesafe Laser Illuminators for ID)**

**Lower Logistics Costs**

**No more cryo-cooler - "lowest reliability component"**

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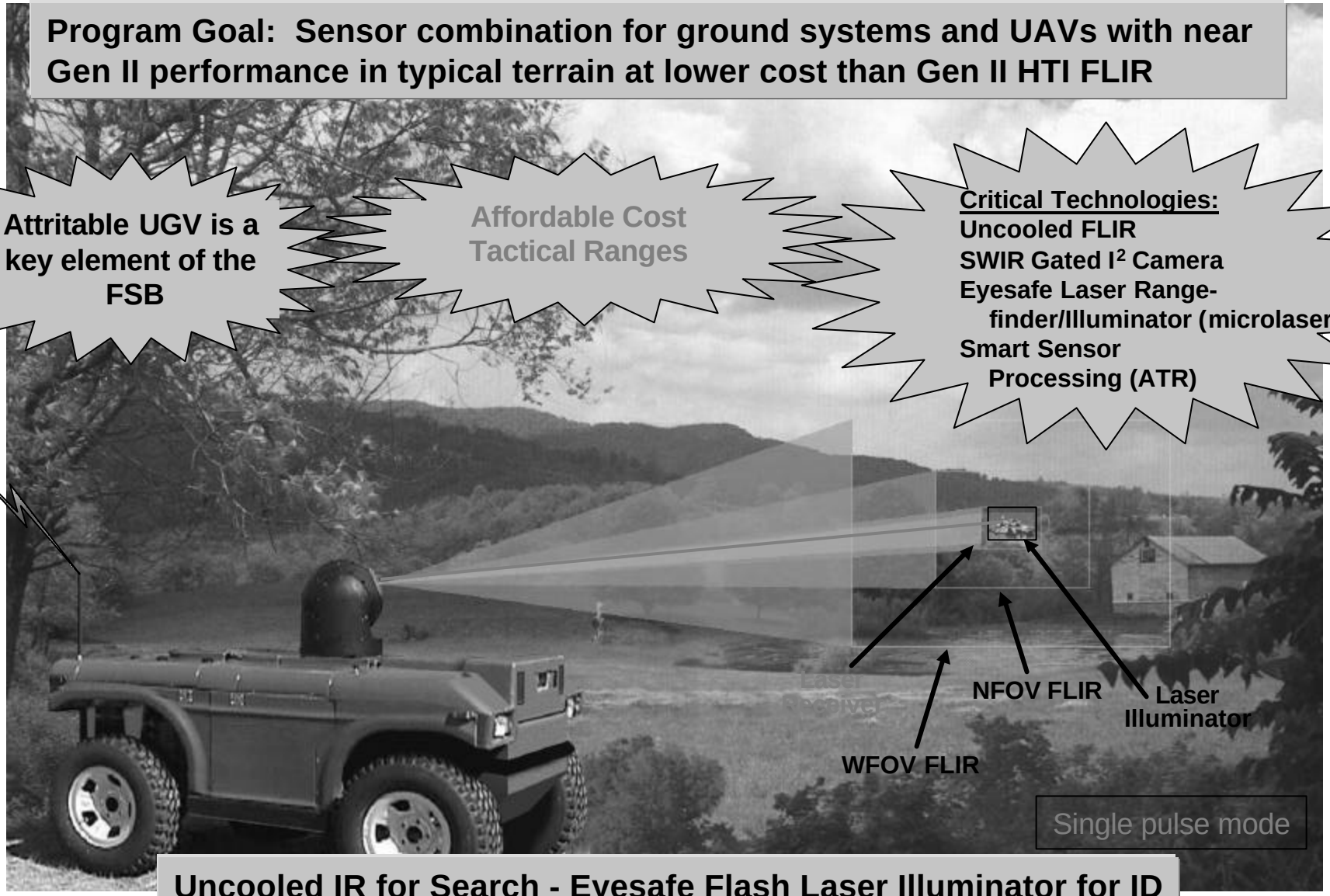
# Cost Effective Targeting Sensor Suite for UGVs

**Program Goal: Sensor combination for ground systems and UAVs with near Gen II performance in typical terrain at lower cost than Gen II HTI FLIR**

**Attritable UGV is a key element of the FSB**

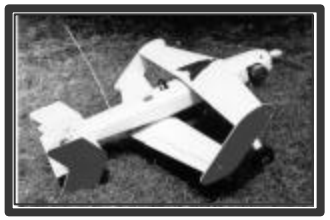
**Affordable Cost Tactical Ranges**

**Critical Technologies:**
**Uncooled FLIR**
**SWIR Gated $I^2$ Camera**
**Eyesafe Laser Range-finder/Illuminator (microlaser)**
**Smart Sensor Processing (ATR)**




**Uncooled IR for Search - Eyesafe Flash Laser Illuminator for ID**

# *Mini-UAV Technologies*

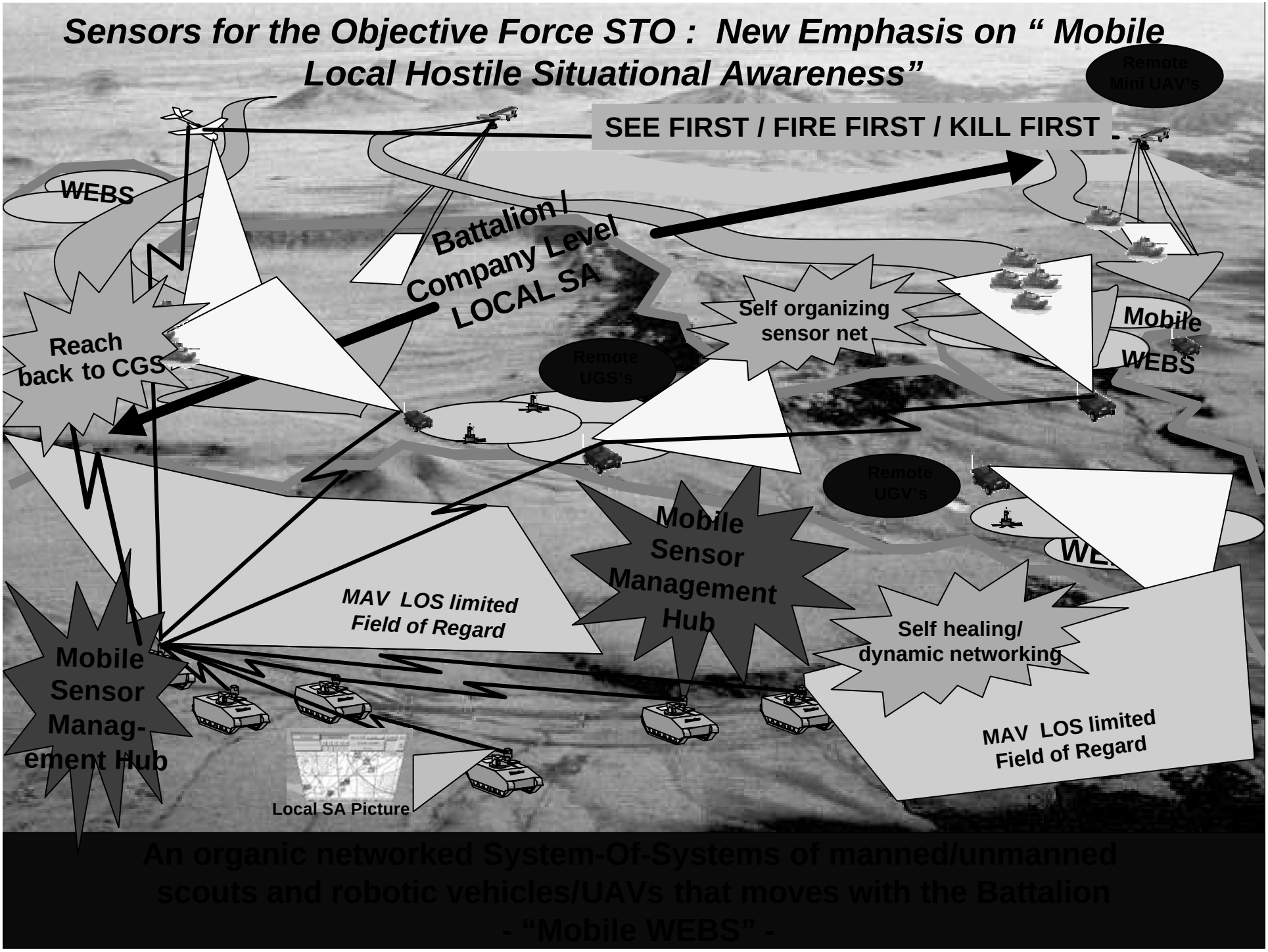


| | **Mini Air Vehicles (DARPA)** | **Pointer (NVESD/USMC)** | **Back Pack (NVESD FY00 Congressional Plus Up)** | **Cypher (NVESD/USMC)** |
|---|---|---|---|---|
| ***Wingspan*** | ***36 inches*** | ***9 ft*** | ***36 inches*** | ***56-72 inches*** |
| ***Max TO Weight*** | ***2.25 lbs*** | ***12.5 lbs*** | ***25 lbs*** | ***200 lbs*** |
| ***Payload Weight*** | ***0.56 lbs (9 oz)*** | ***2.0 lbs*** | ***8 lbs*** | ***50 lbs*** |
| ***Sensor*** | ***CCD + Growth to LWIR*** | ***CCD or LWIR with Growth to Acoustics*** | ***CCD + Growth to LWIR*** | ***InSb FLIR + Growth to Large Format & Drop Sensors*** |
| ***Fuel*** | ***Battery*** | ***Battery*** | ***Oil/Alcohol or MOGAS*** | ***MOGAS*** |

**NVESD /AATD/AMCOM MOU to Develop an Integrated Sensor w/ Mini-UAV**

**Uncooled IR permits day / night imaging from mini-UAV**

# *Sensors for the Objective Force STO : New Emphasis on " Mobile Local Hostile Situational Awareness"*




An organic networked System-Of-Systems of manned/unmanned scouts and robotic vehicles/UAVs that moves with the Battalion

- "Mobile WEBS" -

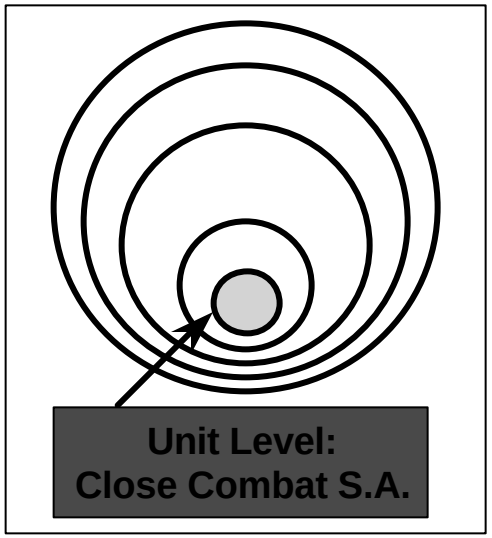
# *Close Combat Situation Awareness*

## Relevance :

**The new challenge: dismounted threats in a complex terrain**

**Contingency operations in complex terrain (including MOUT) requires 360[d] close-in hostile situation awareness and reliable target identification (vs. civilians) at night without exposing crew:**

- **Also need connectivity with the U.S.dismounted infantry for coordinated attack**
- **and at a reasonable price for the infantry vehicle**
- **targeting range adequate for medium caliber gun**




**Applications:**

**Infantry Commander (short range gun)**
**Fighting vehicle driver (contributes to target acquisition)**
**Mounted infantry (situation awareness just before dismount)**

## The solution:

**Head Tracked Vision System using :**

- **High performance uncooled IR imaging (improved logistics/ no crycooler)**
- **Laser pointer with I2 / IR Fusion**
- **Eye-safe flash laser imaging for ID**

**Head Tracked Systems provide rapid all-around view with adequate resolution**

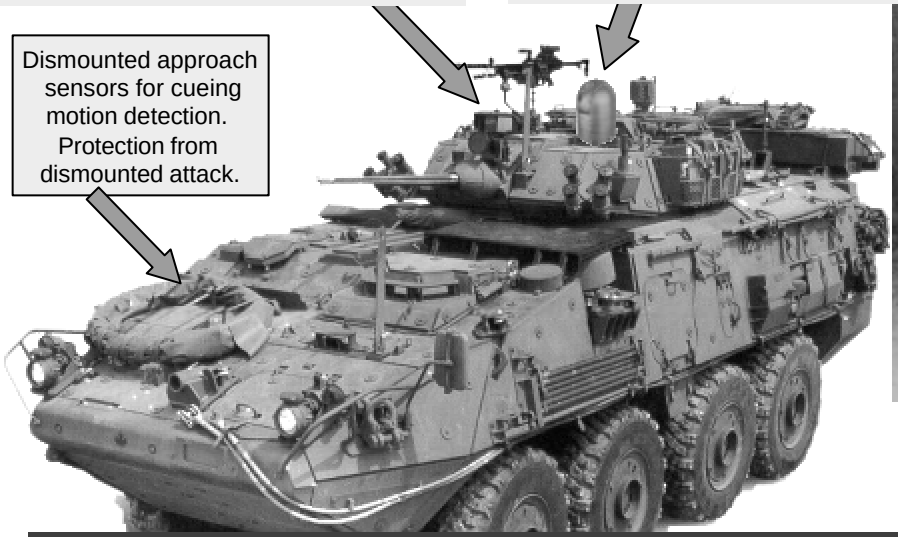
# *Close Combat Situation Awareness*
# *Head Tracked Viewer and Target Acquisition System*
# *HTV/TAS (for URBAN vs. Dismounted)*

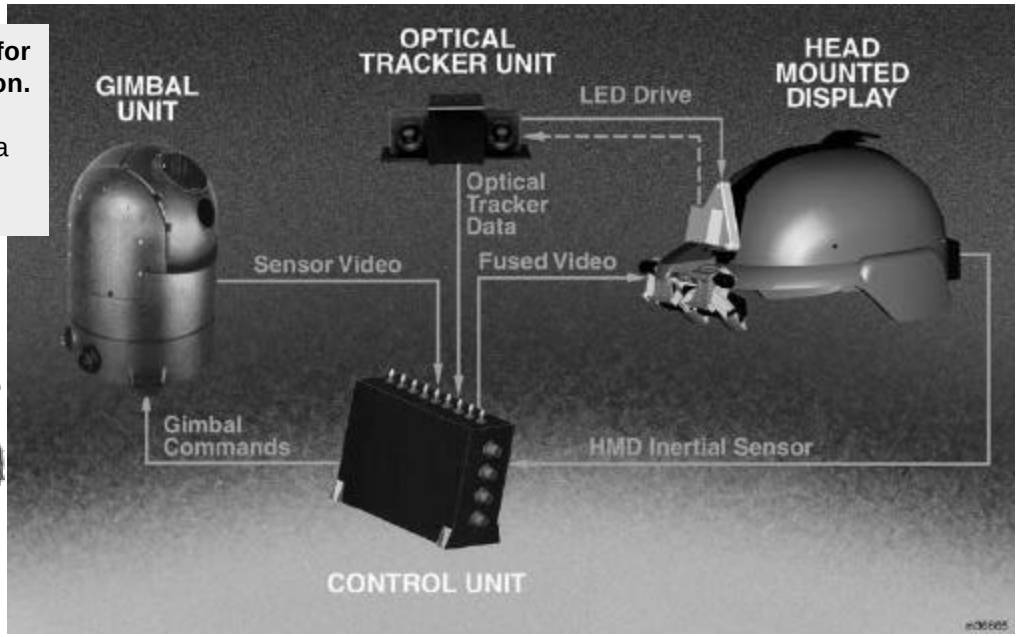
***All around near-vehicle SA at significant cost reduction for protection from dismounted attack-an Infantry School high priority***

**Target Acquisition Sensor Suite for extended engagements.**
- Uncooled Gen 3 FLIR
- SWIR camera
- Micro Laser rangefinder / Illuminator

**Commander's Viewer Suite for 360º x 90º SA and acquisition.**
- Uncooled Gen 3 FLIR
- Intesified Gated CCD camera
- High power pointer
- RF intrusion detection

Dismounted approach sensors for cueing motion detection. Protection from dismounted attack.






The HTV/TAS provides an affordable 360º (h) X 90º (v) dome of situational awareness, protection and target acquisition to brigade vehicles, especially in closed hatch and night time operations in difficult operational scenarios. - Urban fights. Pointer connectivity with dismounted

# *Long Range On-Board Targeting*

**Relevance - See First, Shoot First, Kill First--Line of Sight:**

**--Scout RSTA Vehicle**
**--Missile Carrier (LOS)**
**--Long Range Gun Vehicle**

**ID range capability of baseline sensors is inadequate for coalition low collateral damage warfare**

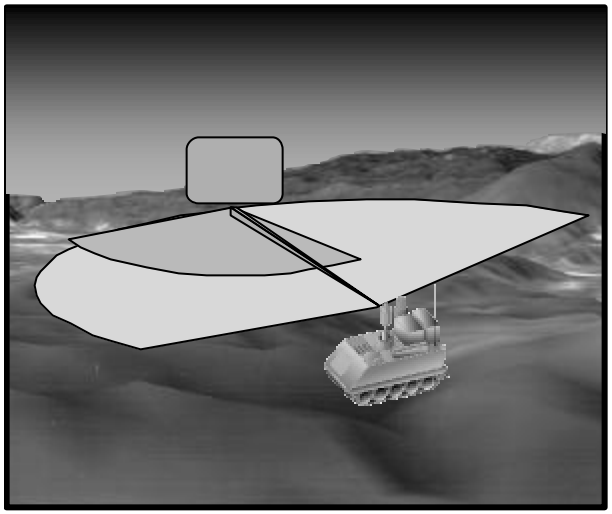
**Baseline: 2nd Gen FLIR - LRASS+ (LWIR TDI)**

**The challenge : Rapid Target Search (gimbal scan with ATR)**
**Longer Range Target ID (shorter wavelength)**
**Detection of Difficult (obscured) targets (multispectral)**
**Scout Placement for Survivability (mast mounting)**

**Solutions: Multispectral Systems and mast mounted operation**
**Include Phased Array Acoustics for BLOS**

# *Long Range On-Board Targeting Strategy for Objective Force and FCS*

## Option 1
**Multifunction Staring Sensor Suite Dual Band**



- Step Stare + ATR for rapid search
- MWIR for long range ID
- Multispectral for Difficult Targets
- Acoustic Cueing

- Totally Passive for Scout
- Multifunction
- On Vehicle or Short Mast
- Pathfinder for Gen III (expensive)

## Option 2
**2nd Gen LWIR + Eyesafe Laser Illuminator**


- Gimbal Scan + ATR for rapid search
- Eyesafe pulse gated laser illuminator for long range ID
- (Shared Aperture MWIR/VISMIR camera alternate for ID)

- Extension of Existing System
- On a Vehicle or Short Mast

## Option 3
**Vehicle Mounted EO/IR (MWIR) TUAV Payload plus Radar**

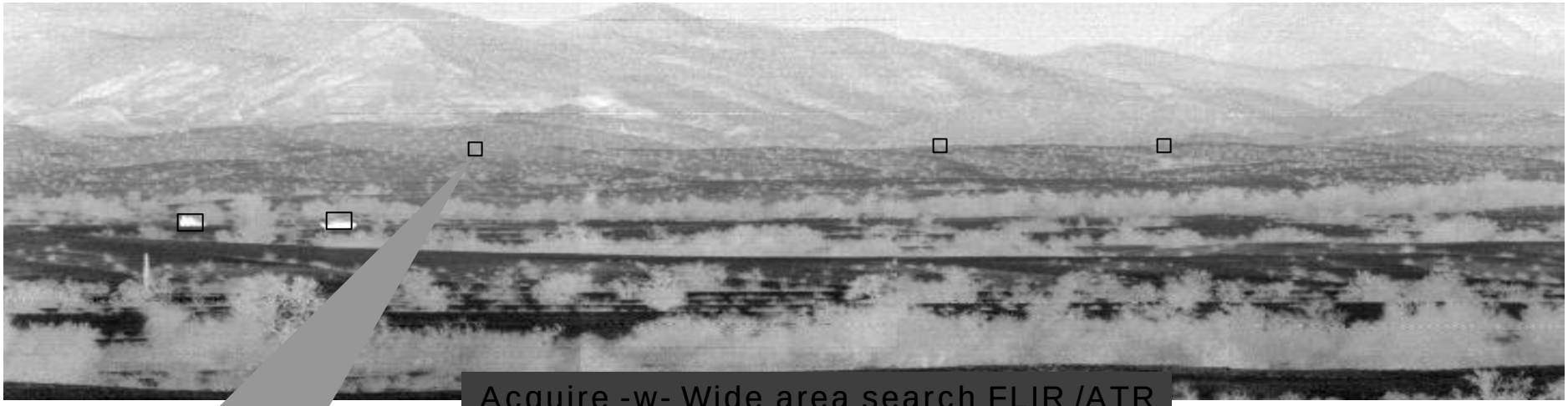
- Low cost/risk/weight (EO/IR, radar)
- MTI s[illegible]

**2 1/2 – 3 Times the ID RANGE**

- Some Degradation vs LWIR in Fog Oil Smoke
- Appropriate for Tall 10m Mast

***Can add laser imaging or radar to any IR system***

# *Rapid Search and Extended Range ID Sequence of Events*



Acquire -w- Wide area search FLIR /ATR

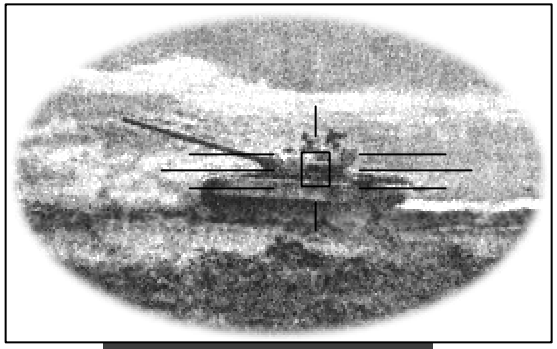
Targets are Searched for and Acquired With the Gimbal Scan 2nd Generation FLIR for Wide Area Search. ATR Automatically Detects Targets and Engages a Multi Target Tracker.

User Selects Target and Fires Muti Function Laser to Determine Range To Target (RTT)

Processor Calculates and Sets Illuminator Beam Divergence and Range Gate Using RTT Data

Automatically activates the MFL, High Power, Eyesafe, Pulsed Mode and Displays a High Resolution, Laser Illuminated Video Image of the Target Using a TE-EBCCD Camera

User ID's Target and Takes Appropriate Action - Designation for PGM possible with Multi Function Laser

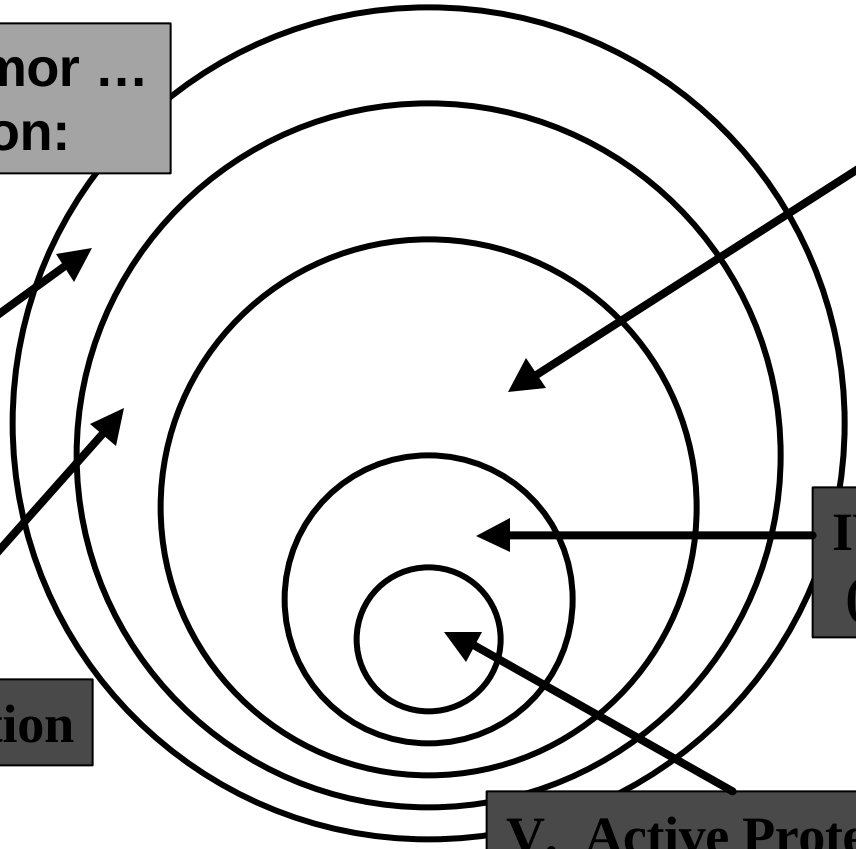


ID -w- SWIR
+ engagement


***IR for Search - Eyesafe Laser Illuminator (1.5 μm) for ID***

# *Integrated Protection*

**Without Heavy Armor … New Emphasis on:**



**I. Terrain Masking**

**II. Signature Reduction**

**III. Threat Warning and Smoke**

**IV. Countermeasures (Decoys and Jammers)**

**V. Active Protection / Medium Armor**

**The Challenge is: I. The variety of Threats**
**II. The Special Challenge of the fast long rod penetrator**

**Need to adopt the Aviation Paradigm but at a reduced cost**

# *Conclusions*

- **Sensors are Critical to a Medium Weight Objective Force - the Key to Survivability**

  **Layered Surveillance for** **See First - Shoot First - Kill First**

- **New Emphasis on <u>BLOS Situational Awareness</u> (distributed off board Sensors)**
  - **Protection vs. dismounted in complex terrain (close combat S.A.)**
  - **and <u>Integrated Protection</u>**
- **<u>Complete Situational Awareness</u> (even against small units in hide) and <u>protection against long rod penetrator</u> (Tank Gun) are <u>big, big</u> challenges Need one or the other - *probably both***
- **Technology emphasis on Uncooled IR, FoPen, ATR, and Long Range ID**
- **For organic ground based systems, cost will be a major driver**

**Additional information about Sensors for FCS is available on the PM-FCS website: <u>www.fcsnet.org</u>**